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(54) Process for making a foam material.

(57) A process for making foam material is disclosed which comprises impregnating comminuted particles of a previously formed foam material with a first foaming reaction solution 6 (e.g. one made up of a polyol, a catalyst and additives) and with a second foaming reaction solution 8 (e.g. one containing diisocyanate). The comminuted particles are also subjected to a rolling pressure when they are being impregnated with the first foaming reaction solution. The impregnated particles are transferred to a forming area 9 provided with steam 10 serving to accelerate the foaming reaction of the impregnated particles. The foam material so produced is provided with excellent properties, in particular good tensile strength and air permeability.

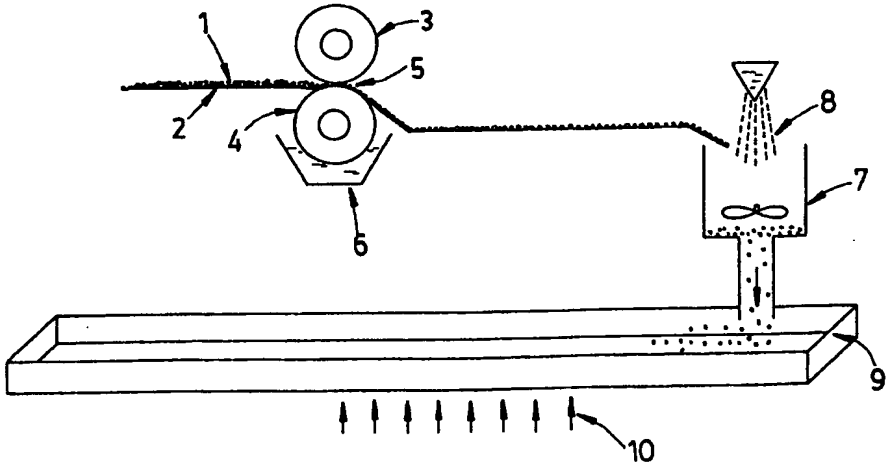

FIG. 2

EP 0 555 568 A1

This relates to a process for making a foam material, and more particularly to a process for making useful foam material from waste foam material.

US-3452122-A discloses a process for making a foam material by bonding together particles of comminuted previously formed foam material and a foamable polyurethane resin composition. The foam material made by means of such a process is provided with superior qualities of high density and high air permeability by virtue of the facts that the cavities of particles of comminuted foam material are filled with the new foam material and that the new foam material penetrates into the particles of comminuted foam material. However, the foam material made by the disclosed process is defective in that it is not provided with the quality of strong tensile strength, because the foamable polyurethane resin composition was found to be incapable of penetrating completely into the particles of comminuted foam material. Therefore, an improved process intended to provide a solution to the problem described above was disclosed in US-4666646-A, which process is characterised in that the particles of comminuted previously formed foam material are dried before they are mixed with the foamable polyurethane resin composition. As a result, the foam material so produced is found to have a greater tensile strength as compared with the foam material made by the first disclosed process mentioned above. It was found that the dried particles permit a relatively greater quantity of foamable polyurethane resin composition to penetrate thereinto. However, this improved process is by no means entirely satisfactory; moreover, it is a time-consuming process.

According to the present invention, there is provided a process for making a foam material, comprising

(a) comminuting a previously formed foam material into particles;

(b) drying the particles to obtain dried particles;

(c) impregnating the dried particles with a first foaming reaction solution to obtain first impregnated particles;

(d) rolling and pressing the first impregnated particles so as to obtain rolled particles;

(e) mixing the rolled particles with a second foaming reaction solution so as to obtain second impregnated particles; and

(f) subjecting the second impregnated particles to steam to facilitate the foaming reaction within the second impregnated particles to take place.

The dried particles may be impregnated with the first foaming reaction solution at the same time as the dried particles are rolled and pressed.

The dried particles may be impregnated with the first foaming reaction solution coated on one of two rolling wheels positioned in such a matter that there is a predetermined clearance located therebetween to effecting the rolling and pressing.

The process of the present invention enables the foamable polyurethane resin composition to penetrate effectively and thoroughly into the particles of comminuted previously formed foam material.

Moreover, by virtue of the present invention, it is possible to accelerate the reaction process of foaming and forming.

One of the first foaming reaction solution and the second foaming reaction solution may comprise a polyol, a catalyst and additives, and the other may comprise a predetermined quantity of a diisocyanate.

A preferred embodiment of the process of the present invention comprises the steps of:

(a) comminuting a previously formed foam material;

(b) drying the particles of comminuted previously formed foam material;

(c) impregnating the dried particles obtained in step (b) with a first foaming reaction solution made up of polyol, catalyst and additives;

(d) rolling the treated particles obtained in step (c), subsequent to or simultaneously with step (c);

(e) mixing the rolled particles in step (d) with a second foaming reaction solution containing a predetermined quantity of diisocyanate; and

(f) introducing the particles in step (e) into a foaming area provided with steam to facilitate the foaming reaction to take place.

The present invention is notable in that it involves the impregnating of particles with the first foaming reaction solution and the rolling of the impregnated particles, enabling the second foaming reaction solution to penetrate thoroughly into the particles. The foam material so produced is provided with excellent physical properties.

The present invention is also notable in that it involves the impregnating of particles with the first and the second foaming reaction solutions and the subsequent transfer of the impregnated particles to the forming area provided with steam to enable the foaming reaction to accelerate.

For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a flow chart of one embodiment of the process of the present invention; and

Figure 2 shows a schematic view of one embodiment of apparatus capable of carrying out part of the process of the present invention.

In the embodiment shown in Figures 1, a first step A involves comminuting a previously formed foam material. This is followed by a second step B

which involves drying the comminuted particles. this is followed by a third step C which involves impregnating the dried particles with a first foaming reaction solution. This is followed by a fourth step D which involves rolling and pressing of the particles. This is followed by a fifth step E which involves impregnating the particles with a second foaming reaction solution. This is followed by a sixth step F which involves transferring the impregnated particles to a forming area where foaming reaction of the impregnated particles takes place.

With regard to steps A and B of Figure 1, conveniently the previously formed foam material is comminuted into particles having a diameter under 3mm. Such comminuted particles are then dried in an oven for a predetermined period of time under a temperature of the order of 150 degrees Celsius. The length of time and the degree of temperature required for the drying step are dependent on the quantity of particles intended to be dried.

With regard to steps C to F of Figure 1, reference is now made to the apparatus of Figure 2 where the following steps are carried out. The dried particles 1 from step B are transported via a conveyor 2 to a nip or narrow clearance 5 located between upper and lower rolling wheels 3 and 4. The lower rolling wheel 4 is partially submerged in a first foaming reaction solution, which is made up of a polyol, a catalyst and additives in a predetermined ratio and is contained in a solution tank 6. When upper and lower rolling wheels 3 and 4 rotate in relation to each other, the particles 1 passing through the narrow clearance 5 are impregnated with the first foaming reaction solution coated on the surface of the lower rolling wheel 4. Moreover, the particles 1 located at the narrow clearance 5 are subjected to rolling pressures exerting thereon respectively by upper and lower rolling wheels 3 and 4 so as to facilitate the first foaming reaction solution to penetrate effectively into the pressed particles 1.

The impregnated particles 1 described above are carried away by another conveyor and subsequently introduced into a mixer 7 along with a second foaming reaction solution 8 made up of TDI (tolylene diisocyanate) and 60% of polyol by weight, which causes the second foaming reaction solution to penetrate the particles.

The particles 1 impregnated with the first and the second foaming reaction solutions are finally transferred to a forming tank 9 provided at the bottom thereof with a steam-generating device. The steam 10 generated in the forming tank 9 is used to accelerate the foaming reaction of the impregnated particles 1.

It is apparent that the particles 1 have been impregnated thoroughly with the first foaming reaction solution before they are subjected to impregnation with the second foaming reaction solution. As a result, the newly-formed foam material is provided with better tensile strength, air permeability and other properties.

Claims

1. A process for making a foam material, comprising
   (a) comminuting a previously formed foam material into particles;
   (b) drying the particles to obtain dried particles;
   (c) impregnating the dried particles with a first foaming reaction solution to obtain first impregnated particles;
   (d) rolling and pressing the first impregnated particles so as to obtain rolled particles;
   (e) mixing the rolled particles with a second foaming reaction solution so as to obtain second impregnated particles; and
   (f) subjecting the second impregnated particles to steam to facilitate the foaming reaction within the second impregnated particles to take place.

2. A process according to claim 1, wherein the dried particles are impregnated with the first foaming reaction solution at the same time as the dried particles are rolled and pressed.

3. A process according to claim 2, wherein the dried particles are impregnated with the first foaming reaction solution coated on one of two rolling wheels positioned in such a matter that there is a predetermined clearance located therebetween to effecting the rolling and pressing.

4. A process according to claim 1, 2 or 3, wherein one of the first foaming reaction solution and the second foaming reaction solution may comprise a polyol, a catalyst and additives, and the other may comprise a predetermined quantity of a diisocyanate.

5. A process for making a foam material, which comprises the steps of:
   (a) comminuting a previously formed foam material;
   (b) drying the particles of comminuted previously formed foam material;
   (c) impregnating the dried particles obtained in step (b) with a first foaming reaction solution made up of a polyol, a catalyst and additives;

(d) rolling the treated particles obtained in step (c), subsequent to or simultaneously with step (c);
(e) mixing the rolled particles in step (d) with a second foaming reaction solution containing a predetermined quantity of a diisocyanate; and
(f) introducing the particles in step (e) into a foaming area provided with steam to facilitate the foaming reaction to take place.

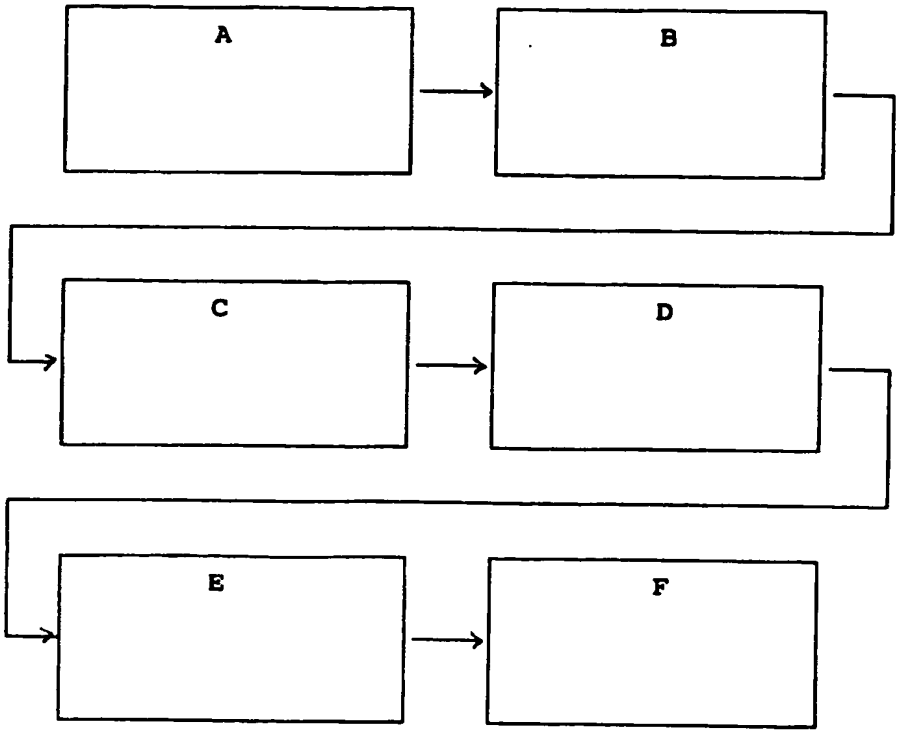

FIG. 1

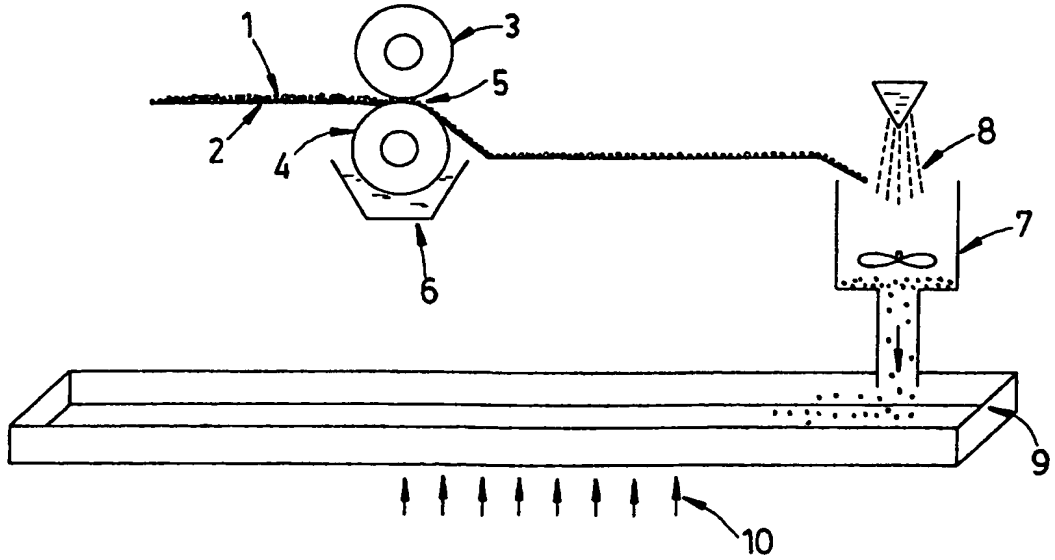

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 92 30 1089

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	GB-A-1 183 371 (THE SCHOLL MFG. CO. INC.) * the whole document *	1-5	B29C67/20 B29B17/00
D,Y	US-A-4 666 646 (CHANG) * the whole document *	1-5	
A	GB-A-2 116 572 (KUN-HUANG CHANG) * the whole document *	1,4-5	
D,A	US-A-3 452 122 (STERN ET AL) * claims *	1,4-5	
A	US-A-4 591 469 (BUCHANAN ET AL.) * abstract * * column 2, line 24 - column 3, line 21; claims 1,3; figures 1-2 *	1,5	
A	DATABASE WPIL Week 8636, Derwent Publications Ltd., London, GB; AN 81-54262D & JP-B-61 034 737 (ORIENTAL METAL SEIZ KK) 9 August 1986 * abstract *		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B29C B29B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 OCTOBER 1992	JENSEN K.S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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